February 16, 1860.

Sir BENJAMIN C. BRODIE, Bart., President, in the Chair.

The following communications were read:—

I. "Description of an Instrument combining in one a Maximum and Minimum Mercurial Thermometer, invented by Mr. JAMES HICKS." By BALFOUR STEWART, Esq. Communicated by J. P. GASSIOT, Esq. Received Feb. 7, 1860.

About a fortnight since, Mr. James Hicks, the intelligent foreman of Mr. L. P. Casella, Optician, called at Kew Observatory with an instrument of the above description, for the purpose of having it compared with the ordinary maximum and minimum thermometers. This comparison proving very satisfactory, and the principle of the instrument commending itself to Dr. Robinson, Mr. Gassiot, Professor Walker, and several other scientific men who examined it, Mr. Gassiot requested me to write a short description of it, which he thought might be of interest to the Royal Society. For many particulars of this description, I am indebted to Mr. Casella and Mr. Hicks, who furnished me with details regarding the construction of the instrument.

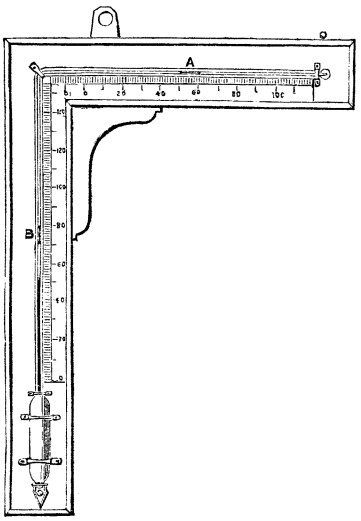
Its chief advantage consists in its furnishing us with a mercurial minimum thermometer, no serviceable instrument of this description having hitherto been made. At the same time it is also capable of being used as a mercurial maximum thermometer.

The principle of the instrument is briefly as follows:—

It has a cylindrical bulb nearly $3\frac{1}{2}$ inches long and half an inch in diameter, filled with mercury. This gives a bore nearly $\frac{1}{20}$th of an inch wide, and a scale on which 1° Fahr. corresponds to about $\frac{1}{20}$th of an inch. When the graduation has reached 150° Fahr. or so, both the tube and the scale are made to assume a position at right angles to that which they occupied previously, so that the first portion of the thermometer being vertical, the second will be horizontal. The numbers on the horizontal scale are not, however, in continuation of those on the vertical; for in the instrument from which this account is taken, while 150° is the highest division on the vertical scale, the first on the horizontal is −10°, the next 0°, the 3rd 10°, and so on. The reason of this method of graduation will immediately appear.

Above the mercury there is a small quantity of spirits of wine, which extends some distance into the horizontal tube. The quantity of this, and the graduation, correspond in such a manner, that the extreme end of the spirit column denotes the same degree of temperature as the mercury. The remainder of the horizontal tube is filled with air. There are two moveable indices in the spirit column, one in the vertical tube, the other in the horizontal, each about half an inch long. The former, B, consists of a fine steel magnet enclosed in glass. This forms the body of the index. At either extremity there is a head of black glass, similar to that which occurs in the index of an ordinary minimum thermometer. A fine hair is tied round the neck of this index, between the body and the upper head; and it is made to hang down by the side, so that by its elastic pressure against the tube, the index may be kept in its place, notwithstanding its verticality. The index in the horizontal tube A, is in all respects similar to that of an ordinary minimum thermometer.

Let us now suppose the instrument fixed in its position, the first part of the stem being vertical. In order to adjust it, we must first bring the vertical index into contact with the upper extremity of the mercurial column. To do this, let us take two small but strong horseshoe magnets, and lay the one above the other, so that the poles of the one shall overlap to a small extent the corresponding poles of the other. Bring the magnets up to the index in such a manner, that, while the poles of the one bear against the side of the glass tube, the overlapping poles shall lie over the tube so as to be in front of the index: the index will now follow the motion of the magnets, and it may thus be brought down to the surface of the mercury. In order to bring the horizontal index to the extremity of the spirit column, all that is necessary is to incline the horizontal tube a little downwards by pressing on the end.



The indices being now set and the instrument in adjustment, let us suppose the temperature to rise; the mercurial column will push the vertical index up, but this index will remain in its place when the mercury again falls, and will therefore denote the maximum temperature reached. On the other hand, let us suppose the temperature to fall. The mercury in falling is followed by the spirit column propelled by the air behind it. The spirit column, again, will, on its edge coming in contact with the end of the horizontal index, draw the index with it into a position, where it will remain when the mercury again rises. This index will therefore register the extreme minimum point which the spirit column has reached; but by the principle of graduation, this will correspond with the minimum point reached by the mercurial column.

Let us now suppose that a small portion of the spirit column has become separated, and lodged itself in the extremity of the tube. The principle of graduation will immediately enable us to discover this, by a want of correspondence being produced in the readings of the mercurial and of the spirit column. If, for instance, before the separation, the mercury read 50°, and the horizontal extremity of the spirit column also 50°, it is clear that, after the abstraction of spirits has taken place, the horizontal column will read lower.

We have thus a check upon this possible source of error, which we have not in the ordinary minimum thermometer. Indeed, it is to all intents a mercurial minimum thermometer that we are now describing, the spirits serving merely as a vehicle for the indices. It will be remarked, that were both columns capable of acting in a horizontal position, there would be no necessity for the bend, and the instrument would be more portable; but in this position it is found that there is danger of the spirits becoming mixed with the mercury, and thus interfering with the action of the instrument. Should this ever be brought about by travelling, or any other cause, a smart jerk or two of the instrument will join the separated columns and put all right.

The instrument is thus constructed:—The vertical tube, including the bulb, is first made and filled with mercury to the proper height, and the magnetic index is introduced; then the horizontal tube is joined, and the spirits of wine and the horizontal index are introduced. The bulb is then placed in a freezing mixture, in order that the

mercury may retreat as far as possible, followed by the spirits of wine. The tube is then sealed, care being taken that the bore shall end in a small rounded chamber; for if pointed, some of the spirits would be apt to lodge there, whence it would be difficult to remove it. The object of cooling the bulb before sealing off, is that we may have as much air in the tube as possible; for its pressure, as already mentioned, enables the spirits to follow the mercury when the latter falls.

To graduate the instrument, set it with the mercurial stem horizontal in melting ice, then point off the extremity of the mercurial, and also of the spirit column as corresponding to 32° Fahr. Perform a similar operation in water at 42°, 52°, 62°, &c., and also in freezing mixtures down to zero, or lower if necessary.

In conclusion, if used as a wet-bulb thermometer, this instrument will give us the maximum and minimum temperatures of evaporation obtained under precisely the same circumstances.

II. "On the Expansion of Metals and Alloys." By F. Crace-Calvert, Esq., F.R.S., and G. Cliff Lowe, Esq. Communicated by Mr. Calvert. Received December 1, 1859.

[Abstract.]

One of us having been engaged for some time in investigating several of the properties of pure metals, it was thought desirable to take advantage of having pure metals at our disposal, together with a series of definite alloys of those metals, to determine their rate of expansion. And we were encouraged in pursuing this course of investigation, by finding that several of the authors who had previously published tables of the expansion of metals differed widely in their results. These discrepancies, having reference to some of the metals most extensively used, might, we thought, be due either to the method employed, or to the fact that metals of different degrees of purity had been experimented upon. Therefore, being sure of the purity of the metals that we intended to employ, we had recourse to a method the accuracy of which we trust will appear satisfactory.

Owing to the difficulty of obtaining the metals in a pure state in large quantities, we found it necessary to employ square bars, having